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COVER: A Landing Craft Air Cushion (LCAC) comes ashore at Cap Haitien during the recent Haitian operation. An innovative use for this unusual craft in medical evacuations appears on page 14. Photo by CPL P.S. Royston, USMC.

Navy Preventive Medicine Technician School Moves to San Diego

LCDR Daniel W. Peake, MSC, USN

After 44 years, 146 classes, and 2,500 graduates, the Navy's Preventive Medicine Technician (PMT) School graduated its last Oakland-based class on 30 Sept 1994. PMT School reopened at the Naval School of Health Sciences (NSHS), San Diego, CA, on 11 Oct 1994.

History

PMT School's origins are tied to the onset of the Korean War. Following World War II, the Navy Medical Department recognized a significant lack of personnel training in military public health or preventive medicine. The result was the establishment of the Environmental Sanitation Technician course on 1 Nov 1950. Because of increasing emphasis on disease prevention, the course's name was changed to Preventive Medicine Technician in 1963. In 1972, the course was formally designated as a school.(1)

From its 1950 establishment through 1988, PMT School was organized under the command of the Naval Hospital, or the Naval Regional Medical Center, Oakland, CA. On 1 Oct 1988, PMT School was joined by Surgical Technologist and Basic X-Ray Technician Schools to become departments within NSHS San Diego's Oakland Detachment. This move firmly established the school's operation under the Naval Health Sciences Education and Training Command (HSETC), Bethesda, MD. The school continued to flourish, experiencing an era of new training resources under HSETC's management.

No traces remain of the first PMT School building. It was demolished in the mid-1960's for the construction of the present Naval Medical Center which opened in 1968. Soon afterward, the school moved into the topside spaces of Building 101 and has remained there ever since. During the past 25 years, several building modifications have occurred in Building 101. The old student lounge became a conference room, the training aids storeroom became the student lounge, and the PMT library was converted to a student computer laboratory. Built during World War II, Building 101 began to show its age and had outlived its useful service life.

Replacing 44 years of tradition is not easy, but relocating to San Diego had many advantages that outweighed the benefits of staying. Local BRAC initiatives would have forced the school to find a new home anyway since Naval Medical Center Oakland is scheduled to close in 1996. PMT School moved into a modern building equipped with state-of-the-art educational technology. The school is now located near the major West Coast fleet and Fleet Marine Force operational bases. Professional preventive medicine officials at Naval Medical Center San Diego, Navy Environmental and Preventive Medicine Unit No. 5, and the Naval Health Research Center eagerly awaited the school's arrival. Disease Vector and Ecology Control Center, Alameda staff will visit the school periodically to train and certify the students as pesticide applicators.

Photo by the author

Air Sampling Laboratory instructor HMCS Eugene Dogan (right) with Navy and Coast Guard students.

PMT School Mission

A primary mission of the Medical Department is to safeguard the health of Navy and Marine Corps personnel. This is largely accomplished through a preventive medicine program which emphasizes the preservation of health and maximum effectiveness of the individual. A Navy PMT is "the public health department" aboard naval vessels and in Marine Corps battalions, often serving independently of commissioned public health professionals. This independence characterizes the difference between Navy PMTs and the technicians of the other armed services. To prepare the PMT for this challenge, the school's curriculum is a comprehensive 6-month course of instruction in military public health.

The current PMT School curriculum includes 1,040 hours of instruction in Public Health Administration; Public Health Microbiology; Mathematics for the Sanitarian; Water, Wastewater and Solid Waste Management; Biostatistics, Epidemiology; Food Sanitation Technology; Occupational Health and Safety; Medical Parasitology; General Sanitation; Lesson Planning and Development; Operational Sanitation; Medical Entomology and Pest Control Technology; and Field Training. PMT School graduates are certified as Department of Defense Pesticide Applicators, Vessel Quarantine Inspectors, and Food Service Sanitation Instructors. PMT students earn 48 equivalent semester hours from the Americam Council on Education.

PMTs serve in all areas of the world, aboard large naval vessels, and with the Fleet Marine Force. They have served in every Navy and Marine Corps operational commitment since 1950. They are the eyes and ears of the medical officer, uncovering actual or potential unhealthy situations and taking the correct measures to safeguard the health of their shipmates. PMTs often work behind the scenes, accomplishing many tasks most take for granted. One can find PMTs performing a wide variety of sanitary inspections, collecting epidemiological information, monitoring occupational health and safety programs, providing instruction in all preventive medicine topics, or conducting vector surveillance and control operations. The overall mission of PMT School has been to train hospital corpsmen to accomplish these tasks. From the beginning, PMTs have enjoyed the reputation of consistently performing in an outstanding manner and commanding the respect of naval personnel of all echelons.(2)

The PMT School staff is very excited about our new home. The benefits of field trips and training with operational fleet units based in the local San Diego area, the Fleet Marine Force at Camp Pendleton, daily preventive medicine operations at the Naval Medical Center, and Navy Environmental and Preventive Medicine Unit No. 5 will be of enormous value to our students. Never in the school's history have so many relevant and diverse training opportunities become available for the students. We intend to take advantage of every one of them.

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1. Naval Regional Medical Center, Oakland, CA, Public Affairs Office. *The Oak Leaf.* November 21, 1980;42(24).

2. Janoski T. Training the Navy preventive medicine technician. *J Environ Health.* 1977; 40(3). ❑

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Photo by CDR Konrad Hyashi, MSC

USNS *Comfort* (T-AH 20)

USNS *Comfort* Supports Operation Sea Signal

In May 1994 USNS *Comfort* received a call to activate in support of Operation Sea Signal. During Operation Sea Signal *Comfort* served as an afloat processing center for those escaping the military dictatorship in Haiti. Navy medical personnel from the National Naval Medical Center, Bethesda, MD, as well as several other East Coast commands and naval hospitals augmented the cadre crew to support the medical treatment facility in full operating status (FOS).

Due to the unique mission, Golf Company from the 2nd Marine Battalion, 6th Division (previously 4th Division) out of Camp Lejeune, NC, provided security for the mission. Because it was a joint mission, Air Force, Army, and Coast Guard personnel also augmented for the mission. Civilian personnel from various organizations (Immigration and Naturalization Service, United Nations High Commissioner for Refugees, Department of Justice, and United States Public Health Service) embarked to assist with the political processing. Brief port calls at Norfolk, VA, and Mayport, FL, allowed for the loading of necessary equipment and supplies. On 10 June *Comfort* anchored off Kingston, Jamaica, to prepare for the arrival of Haitians.

Preparing for the migrants' arrival was a very challenging assignment. Different scenarios were simulated to help identify potential problems that might be encountered during actual processing and housing of these refugees aboard the hospital ship. In addition to these preparations, it was necessary to establish other shipboard programs for the efficient operation of a Navy ship.

A major element critical to the missions' success was the role of preventive medicine aboard the hospital ship. Due to the scope and magnitude of the mission an environmental health officer and seven preventive medicine technicians staffed the Preventive Medicine Division. During reduced operating status (ROS) there is

Below: HM2 A.L. Evelyn, a PMT from EPMU-5, fit tests a potential respirator user. *Right:* HM2 Z. Morant, a PMT from the National Naval Medical Center, Bethesda, MD, conducts a respiratory fit testing course for Marines aboard *Comfort*.

no one designated to manage preventive medicine programs; therefore most programs were nonexistent prior to the start of the mission. This obstacle was challenging to overcome, but the preventive medicine staff gave 150 percent and put in the time and effort needed to start the necessary programs. A major benefit was the opportunity to have complete control and flexibility in laying the groundwork of a previously nonexistent preventive medicine program.

Major preventive medicine programs included potable water surveillance; pest control and surveillance; sanitation inspections of galleys, berthing spaces, laundry, and barbershops; heat stress surveillance; heat stress courses; food service sanitation courses; and other typical shipboard preventive medicine programs. In addition, it was necessary to update the crew's immunizations and hold mass immunization evolutions for hepatitis B series, immune globulin, HIV draw, and meningococcal vaccine.

Since there was a high incidence of tuberculosis among the Haitian population it was extremely important to take necessary precautions to protect the crew from contracting this communicable disease. All crewmembers attended an information session on tuberculosis, and baseline tuberculin skin testing was done on all crewmembers including civilians at the start of the deployment.

A PPD (Purified Protein Derivative) data base was created to assist in the tracking of all crewmembers for followup PPD testing. Classes on respiratory protection and fit testing for high efficiency particulate respirators were also conducted for all crewmembers and civilians to protect them from potentially infectious patients. In addition to personal protective measures, environmental control measures were practiced. *Comfort* had an open ventilation system and no effective isolation area for the control of respiratory diseases.

Immediately after disembarking the Coast Guard cutter, the migrants were processed through DMPITS (Deployable Mass Population Information and Tracking System), where they received ID bracelets and demographic data was entered into the computer data base. All migrants then received a chest X-ray to determine the presence or absence of active tuberculosis. Migrants were then placed in tents either on the flight deck or steel beach area where they awaited further processing. If a migrant had a questionable chest X-ray or a suspected case of active tuberculosis they were not allowed to enter the skin of

Some migrants were housed on *Comfort*'s deck.

the ship and they were processed in the open air environment on the flight deck.

Housing migrants in tents on the flight deck and steel beach led to some important considerations concerning availability of water, bathrooms, and food. Bottled water was made readily available to the migrants for drinking and washing purposes due to the lack of a water source in the areas where they were housed. There were portable toilets on both the flight deck and the area adjacent to steel beach for the migrants' use. Each day full portable toilets were moved off the ship by crane and onto a liberty boat for transfer ashore to be emptied and cleaned. Lastly, a meal of beans and rice along with juice and fresh fruit was served to the migrants at meal time. Mess cooks prepared their meals and a team led by the dietitians delivered the food to the migrants.

Whenever large numbers of people live together in such a confined space it is important that the highest levels of sanitation be adhered to. Good sanitation decreases the chance of a communicable disease outbreak and leads to a higher standard of living. The Preventive Medicine Division held daily inspections in areas where migrants were housed and processed. This helped identify problems and facilitated recommendations for improvement. In addition, a preventive medicine technician augmented the ward cleanup team (a team of Navy personnel that cleaned all migrant processing areas on a 24-hour a day basis) to ensure that proper cleaning procedures and personal protective measures were adhered to.

Even though this mission posed some serious challenges for the crew and some unique preventive medicine demands, the overall mission was a success. For the first time migrants were successfully processed for political asylum at sea on board a naval vessel. In July when President Clinton's policy for accepting migrants changed, the migrant processing mission stopped.

On 17 July *Comfort* made a port call at Guantanamo Bay, Cuba, to drop off the remaining migrants before returning to the United States. Even though the migrant processing mission on board the *Comfort* stopped, the preventive medicine mission continued. Four preventive medicine technicians and the environmental health officer from *Comfort* were asked by the Joint Task Force 160 Surgeon to stay at Guantanamo Bay and help establish a proactive preventive medicine program for the migrants. With an offer like that who could refuse? ❑

—Story and photos by ENS Lara L. Massart, NAVENTUNTMEDU-2, Norfolk, VA.

Corpsman at Iwo

If one had to choose a single image from World War II depicting valor and the triumph of the American fighting man, Joe Rosenthal's immortal photograph of the flag raising on Iwo Jima would be that picture. In February 1945, the strategic bombing campaign against Japanese cities was in full swing. To get there and back, B-29s based in the Marianas faced an almost 3,000-mile round trip. For a bomber with battle damage or mechanical trouble, the odds for making it all the way back were not good. Iwo Jima, approximately halfway between Guam and Japan, would provide the "superforts" a much-needed base and improve the odds considerably. The island had to be taken.

Planners anticipated a 3-day operation to capture the tiny 8-square-mile island. They were wrong. Instead, it took nearly a month of some of the bloodiest and most vicious fighting the Marines had ever witnessed. And when they were through, the American flag atop Mt. Suribachi would become the enduring symbol of the Marine Corps. Pharmacist's Mate Second Class Stanley Dabrowski accompanied the Marines ashore and stayed with them until the end.

Stanley Dabrowski, from New Britain, CT, was 17 years old and just out of high school in 1943. Like other young draftable men he decided the infantry was not for him. "After all," he points out, "the Navy had nice clean sheets and berths, three square meals a day, beautiful big battleships, carriers, destroyers...." With an interest in medicine, he decided the Hospital Corps was for him.

After an 8-week course at the Naval Hospital at Portsmouth, VA, he reported for duty at the U.S. Naval Hospital in Charleston, SC, where he was assigned to the contagious ward. Finding the work routine and unchallenging, he requested a transfer. Soon his name was on the list for the Fleet Marine Force and he was to report to Camp Lejeune, NC, for Field Medical Service School. "Fleet Marine? This must be sea duty," he thought, but not the kind he expected.

We got off the bus at Camp Lejeune and I looked around and said, "Gee, there's no Navy here. It's all Marine Corps green. Everything is USMC." We didn't even have white underwear; everything was green. Standing there on the asphalt was a Marine corporal with a Smokey the Bear hat and his duty belt, starched shirt with the creases right down here, very neat.

"All right you guys, fall in." He impressed me tremendously and was our D.I. throughout our training.

Our training included all the things that one has to know about field medicine but more importantly than that it was just like going through Marine boot camp—close order drill, infiltration courses with live machine gun fire, crawling under barbed wire, hand to hand combat. We spent 2 weeks on the rifle range—M1 Garand, M1 car-

Photo by the Editor

Left: **Navy chaplain LTJG John H. Galbreath (center with canteen) comforts a seriously wounded marine on an Iwo Jima invasion beach.** ***Above:*** **Stanley Dabrowski today.**

bine, .45, machine gun, hand grenades, even a bayonet course, would you believe. They had to prepare us for what we were going to face but nobody ever told us what combat was going to be like.

After about 10 weeks of training at Camp Lejeune, we were assigned to the new 5th Marine Division being formed at Camp Pendleton, CA. I was assigned to Company C of the 5th Medical Battalion of the 5th Marine Division. And as a medical company in a medical battalion, C Company was assigned to an infantry regiment, the 28th Marines. A medical company consisted of about 98 corpsmen, 3 surgeons, 2 internists, a dentist, and an administrative warrant officer. I was part of a pool of corpsmen that would staff the battalion aid stations or regimental aid stations. Parts of the company would also staff division or regimental hospitals.

I was assigned to a 13-man medical collecting team. Our job was selecting casualties that needed attention first. We were to transfer them to better facilities as soon as possible. We had four stretcher teams assigned to us. The corpsmen were to do the histories, tagging, and administering first aid. The training was fantastic and everyone knew exactly how we were going to do all these things. We did it repeatedly until we could do it in our sleep.

After 6 months of intensive training at Camp Pendleton, including amphibious assaults on nearby beaches, we went overseas on September 19, 1944. Our first stop was Hilo on the big island of Hawaii and then on to Camp Tarawa. Then we got into intensive training. And we trained and trained—amphibious exercises along the beaches and infantry assaults. Our job was to set up the aid stations, apply battle dressings, administer medications properly, tag and evacuate the wounded, the whole bit.

One thing always stood out in our minds. Every time we went on these

so-called field problems—the Army called them maneuvers—there was always a hill involved. One battalion would turn to the right, another battalion would go straight across, and another battalion would assault the hill. It wasn't until we saw the first picture of Iwo Jima on our way there that it dawned on us why. That hill was Mt. Suribachi! And the 28th Marines were the conquerors of Mt. Suribachi.

We left Honolulu in January of '45 to go to Eniwetok in the Marshalls for a few days of rest and relaxation and refueling, etc. I was assigned to LST-758 which was Coast Guard manned. We had our final dress rehearsal off Saipan and Tinian on February 12th. We then started steaming toward our destination.

It wasn't until we were out to sea, when nobody could get off, that we were told officially that our objective was Iwo Jima. That was on February 13th. They broke out maps and models of the island made of rubber or clay. It showed us our assault beaches where we would land, the airfields, the mountain, the whole bit. They also told us that D-day was February 19th less than a week away; H-hour was 0900.

Iwo Jima

We were off Iwo Jima on the eve of the 19th but everything was black. We didn't see the island. Reveille was about 3 a.m. We had the typical breakfast of steak and eggs but not many people ate an awful lot because your heart was up in your throat. We had no idea what to expect. When we had been briefed on the operation, they told us it would be a 3-day operation. Well, that didn't seem so bad.

I carried a carbine and a .45. Unlike the army in Europe, the medical people were armed. At Guadalcanal, corpsmen still wore red cross brassards on their arms and a red cross on their helmets. They were the first ones to be knocked off by snipers. In the Marine Corps, nobody wore any kind of insignia on their helmets or clothes. Even in subsequent campaigns corpsmen would be singled out simply because they looked different from others because of the equipment they carried. We carried kits which I didn't like at all because they marked us as corpsmen. It was like a lieutenant or a captain carrying a map case as opposed to an infantryman who had only a rifle and a canteen on his belt. Because of this, we were told to carry sidearms not as offensive weapons but for self-protection.

I had a medical kit on each shoulder. In the left pouch we carried all our battle dressings, sulfa powder, burn dressings. In the right pouch were morphine syrettes, tags, iodine pencils, ammonia inhalants, hemostats and scalpels, and other assorted equipment.

Well, anyway, we got down to the tank deck and got aboard our vehicles—the LVTs (landing vehicle tracked). There were 14 men plus equipment in my LVT. We were taking medical equipment—stretchers, etc. We got off at 0800; just drove off the ramp into the sea. We were about a mile off the beach bobbing along with many other ships, mostly LSTs, APAs right behind us, small LCIs, small gunboats with rockets. You could see the smoke and the fire and the fantastic amount of noise and wondered how anything could survive something like that.

We bobbed around while they formed the assault waves. This was very important. You had to get in line. On paper it was a beautiful thing and if you had been up in the air it must have been a thrilling sight. But as soon as we got on that beach everything fell apart. It was just mass confusion and units got scattered. The thing I noticed immediately was the tremendous amount of noise, concussion, small arms fire, explosions of artillery and mortar shells. As we were coming into the beach, we were under a rolling barrage of the 16-inch guns of the battleships. You could just feel those shells going over your head. My unit, part of the 28th Marines, landed in the third assault wave at 0907 on Green Beach, right under Suribachi.

When we landed the only thing we heard was the incoming, the stuff we were throwing at them. The beaches were relatively quiet but for heavy small arms fire. Occasionally, a mortar or artillery shell would land but it seemed as though the Navy had done a good job of knocking out their big guns.

But then, about an hour or hour and a half later, we started getting hammered with the most intense fire, to most everybody's surprise. We just couldn't believe the kind of fire that began coming down on us—mortars, artillery, rockets, the whole bit. It was so intense and the carnage and the wreckage on the beach so fantastic, that subsequent waves could not get ashore that afternoon.

The beach was very narrow because the winds and the waves had terraced the volcanic ash. There were two or three terraces. Just trying to crawl up this thing was like trying to crawl through buckwheat in a bin. Iwo Jima was a volcanic island and the beaches were not sand but volcanic ash. It was very soft. We stepped off and were in up to our ankles. I lost a very dear friend right there on the beach, Stan Sanders. He was sewed through by machine gun bullets. It was the most shocking thing you could experience. Here you were talking to the man just a few minutes ago. I ran to him and his eyes were glazed over

Photos from BUMED Archives

An abandoned Japanese air raid shelter on Iwo Jima serves as a first-aid station.

and he was dead. It was a devastating experience. Everyone was saying, "Move, move, move." And then from everywhere were these pleas, "Corpsman, corpsman!" Once we began to take heavy fire, casualties mounted tremendously.

My first casualty was a sergeant with a sucking chest wound. He had taken a machine gun bullet right through the lungs. One of the paramount things we had trained for were sucking chest wounds. You had to do something immediately or else the man would drown in his own blood. You had to close off the wound so he would not get air through the wound. You had to ram this big battle dressing into the wound and compress it as much as possible and tie it off. Give him a shot of morphine, write out a tag, and mark him; this was another thing that was very important. You had to put a big "M" on his forehead to indicate that he had already been given morphine. And then someone would have to drag him off the beach. I could not do this. I had to advance with my unit.

As it was, we had to catch up with our units. The Marines were trained to move—to push to reach an objective. They just went and we had to go along with them. My battalion was assaulting across the narrow neck of the island and we were catching all our fire from Suribachi. The people who were entrenched up there could see all over the island. The 28th Regiment was supposed to cut Suribachi off from the rest of the island. By the end of the first day, the Marines had gotten across to the other side of the island, cutting it in two.

The first night and second day on Iwo were nightmares. Not only were we under constant heavy fire, but it started to rain and was cold, so we were all really miserable. However, things slowed down because we had ceased advancing and were in defensive positions.

By this time there was some semblance of order. We didn't have an official aid station as such. We chose the deepest shell hole we could find and started taking care of the severely wounded. The battalion aid stations were never very far away from the front line, or at the beginning, from the beach. So evacuating casualties was a short trip. But when we started experiencing heavy casualties, it was almost impossible to comprehend.

The first thing you had to do was assess the casualty. Almost certainly, they had immediately gone into shock. Combating shock and hemorrhage were the first priorities. We used tourniquets and hemostats. There were so many cases where there were traumatic amputations—no arm, or both legs. And then there were abdominal injuries—torn out intestinal tracts. Often I was beside myself trying to decide what to do with these people. And surprisingly, sometimes these young men—of course we were all young—would be covered by a poncho and lying on a stretcher. And I'd say, "Hey Mack, how are you doing?"

"Pretty good, Doc."

"What's the problem?"

"Oh, my left arm got it." So you'd lift the poncho and you'd see a stump. "My God," you'd think, "he's still lucid and he still can talk."

First, I had to tourniquet it, give him morphine. We had these huge battle dressings about the size of an 8 1/2 by 11 page of paper with ties on them. You would sprinkle sulfa powder on the stump, which would almost immediately be washed out by the oozing blood. But you did it nevertheless. And then you'd put the dressing on as tightly as possible. These men—the resolve they had.... You'd tag them, get their name and number off their dogtags. You'd put the man's unit down if you could find out what it was because they always took statistics down at the end of the day as to killed and wounded and what units they were from.

Our fight was preserving life. You did all this automatically. It was just so natural to do these things even though you were never, never, never primed for the things you saw. The injuries to these men were traumatic; so were the experiences.

Nevertheless, we did what we had to do and then we got the stretcher teams to get them down to the beach as soon as possible. At that time the regimental aid station was not set up to take care of them. Things were too

fluid. The beach was the best place to send them so they could be evacuated offshore.

The Flag Raising

As you know, Iwo Jima was not a 3-day affair. I don't think we were at the middle of the second airfield by the third day. The First Battalion of the 28th Marines was by this time put into reserve and the Second Battalion began assaulting Mt. Suribachi. You know the world-renowned photo Joe Rosenthal made of the flag-raising. There were two flag-raisings on Iwo Jima. The first patrol that went up had a small flag brought ashore by the battalion adjutant. I recall very well because we were at the bottom of the mountain at the aid station and I saw that team going up. They met resistance but made it to the summit and put up the flag. Of course, everyone cheered because this was the most important piece of real estate they could take. Once they deprived the Japanese of that observation post things down below got a little cooler.

However, the battalion commander, I think his name was Chandler Johnson, said, "It's a small flag and it's our flag and some s.o.b. is going to want that as a souvenir." He then sent one of his lieutenants to get a bigger flag. The man went down to LST-779 and got a bigger flag. The second outfit that went up Suribachi took this flag. As it was, Joe Rosenthal, an AP photographer went with them and when they got there they found a piece of pipe, lashed the flag onto it, and the six-man team was hoisting the flag up while Joe Rosenthal just happened to click his camera and immortalized the Marine Corps forever.

Getting Wounded

After the 23rd the battalion had a few days rest when we got a little reprieve to resupply, collect the wounded, and get some food. We started again toward the north part of the island. We were right beneath Suribachi. We had bisected the island, and the 4th Division was already pushing north from their sector. By this time two regiments of the 3rd Division had been brought in due to the tremendous number of casualties both the 4th and 5th Divisions had suffered by that time. They ran into some very fierce opposition and it got to a point where it was inch by inch, foot by foot rather than yards at a time.

The terrain above the airfields was very pocked with caves, pill boxes, labyrinths of tunnels, and such a crossfire that it was a murderous situation. You can read this in the historic accounts of the battle—Turkey Knob, the Meat Grinder, and Hill 362, the one that will stand out in my mind forever. This is where our regiment was pinned down by murderous fire. The most terrifying and devastating aspect of combat were the mortar barrages. They came straight down on you due to their trajectory and when they registered you were in for a terrible beating.

Of course, as corpsmen, we advanced with our troops. On the 3rd of March I was administering a unit of serum albumen to a very severely wounded marine in a shellhole, where we had some semblance of safety. I was about 6 inches above ground with my hand holding the serum albumen bottle, a bottle a bit smaller than a coke can. I caught a piece of hot shrapnel which shattered the bottle and almost took the tip of my finger off. The shock of being hit flipped me over. I lost my helmet and another chunk of shrapnel grazed my scalp. Neither wound was severe enough to take me out of commission. But I did have a helluva headache and one big bandage on my finger. And I just continued my duties. Later on, I was showered with the blast from a phosphorus round and was hit in the left knee. Again, I was lucky enough not to have gotten a wound that put me out of commission. However, I did have the latter wound attended to by a surgeon back on the beach.

My most traumatic experience on Iwo Jima occurred in the Hill 362 sector. I was about to get out of a shellhole when I was knocked back down by a mortar round that hit my shoulder pack but did not detonate! *It was a dud.* It was agonizing terror to try to get out of that hole. To this day I shudder when I think of it. There were other close calls, but this one is etched in my memory forever.

Evacuating Wounded

We made trips almost constantly evacuating the wounded. By the time we had advanced further the battalion aid station was in full operation. Understand that it was always mobile. As the troops moved up, we had to follow, otherwise there would be too big a gap between the line companies and medical help. We evacuated the wounded with the tracked vehicles, the LVTs. You couldn't use trucks; there were no roads. The LVTs could go anywhere just like a tank. And we used another little vehicle we called the Weasel, a small tracked vehicle about the size of a jeep. You could do anything with this little thing. We could get two severe casualties on a Weasel.

When we had to do it by hand, our stretcher teams were under constant fire. And the stretcher teams were always singled out by the snipers. Frequently, you would hear these things, pft, pft. It didn't register until after a while that you were being shot at.

The first LST to land on Iwo Jima,

I think, did so on the 21st. The only way we could get the wounded off the beach initially was with the alligators—the LVTs. On that first day there was no way Higgins boats could get ashore because of the tremendous amount of wreckage.

Most of the evacuation was done by hospital ship. The *Solace* (AH-5), the *Bountiful* (AH-9), and the *Samaritan* (AH-10), were at Iwo Jima. Once they were loaded they would steam back to the Marianas. At night they were 15 to 20 miles offshore fully illuminated. Hospital LSTs played an important part during the early phases of the battle, receiving casualties from the LVTs and Higgins boats and distributing them to APAs (assault ships with extensive sick bays) and hospital ships.

I also saw the first hospital plane come in from Guam or Saipan on the 3rd or 4th of March. It had a big red cross on it. We delivered a group of severely wounded to the airfield for air evacuation. The first Navy nurse came on this plane [ENS Jane Kendeigh, flight nurse]. The air evacuation was very important. During the battle better than 2,500 marines, very severe casualties, were airlifted to the Marianas. The planes were able to accommodate three tiers of stretchers. And I understand that they never lost a patient enroute to those hospitals.

The hospital planes also brought cases and cases of whole blood. This blood had just been donated on the West Coast days before. The surgeons began using it immediately. You could see the tremendous response with whole blood as opposed to plasma. You would get color, pink lips again rather than purple. It was fantastically lifesaving and there's no question that the whole blood saved many, many more lives than the plasma or albumen.

Minefield

In one instance, I had a wounded man not 50 feet away. Some of the marines told me that he had been there for about a half hour. "Hey Doc, go out there and bring him back in." He wasn't moaning, but you could see movement. So I figured I would go out and take a look at him. I started across this area and right behind me someone said, "Hey Doc, where the hell do you think you're going?" I said, "I've got a man out there I have to bring in." He said, "The hell you are. You're in the middle of a mine field. Freeze." Talk about traumatic experiences.

Usually, the engineers would indicate an access path with tape or white streamers. They would probe for the mines with a bayonet and clear the area. Apparently, this hadn't been done yet and I hadn't realized it. I was halfway through so I continued and got my man.

In retrospect, when you think of Iwo Jima, we lost 6,821 men, mostly marines, but a good number of Navy people too. I believe 200 corpsmen were killed in action. Better than 600 or so were wounded in action. Two doctors were killed and 15 wounded. C Company of the 5th Medical Battalion lost six killed and about 23 wounded.

Of the 27 Medals of Honor that were awarded on Iwo Jima, 4 went to corpsmen. Two were posthumous. John Bradley, one of the Suribachi flag-raisers, days later was wounded in both legs and evacuated.

After Iwo

My unit left Iwo on March 26th. What was left of our division went back to Camp Tarawa on the big island of Hawaii to regroup mentally and physically. And we were getting our replacements of raw, young people. Mind you, we were old salts as 18- and 19-year-old combat veterans. The replacements looked at us with great awe. After all, we had been on Iwo Jima.

Many of those who had been hospitalized came back to duty. I remember running into the first casualty that I took care of on Iwo. One day we were sitting around when I heard a voice say, "I'm looking for Doc Dabrowski. Dabrowski, where are you?" I recognized him immediately. He gave me this big bear hug and said, "Doc, I just wanted to thank you for saving my life." Now that one thing was worth Iwo Jima to me. It just does something to you. One of the things you constantly have on your mind—you were up to your elbows in grime, dirt, and blood and you're constantly asking yourself, "Am I doing the right thing? Am I doing enough for them?" How many I saved, I don't know. I don't know to this day. How many of those that I tagged did I save? But that's what we were trained for and that's what we did.

When I look back on it, as gruesome as it was, I have a lot of satisfaction knowing that I was part of something that was meaningful.

The 5th Marine Division is no more than a memory, but it is a memory that I will carry all my life. It was born of the terrible necessity of war, and it fought its war among the best. I am fiercely proud of my service with the Marine Corps.

Following the Iwo Jima campaign, "Doc" Dabrowski's Marine Division was assigned to Operation Olympic, the planned invasion of Japan. Even though the Japanese surrender made that last campaign unnecessary, Dabrowski went to Japan in September 1945 as part of the occupation force. He was discharged in December 1945.—JKH

Photos by JO2 Sue Roland

The video link with two doctors in Croatia

Telemedicine:

Reaching Out to the World Through Technology

JO2 Sue Roland, USN

Telemedicine is an up and coming project for the medical community. It allows both audio and video communication around the world. Although still in the fine tuning stage, it will one day be in all Navy medical facilities and probably in isolated areas in the civilian community.

On 1 Sept 1994, Secretary of the Navy, John H. Dalton, visited the National Naval Medical Center (NNMC), Bethesda, MD, and received a briefing and demonstration on how telemedicine works from CAPT Donald Jensen and CDR Dave Lawrence of NNMC's Radiology Department.

The first image was a subtle fracture of a hand sent by the aircraft carrier USS *George Washington* (CVN-73). "This equipment allows us primary diagnostic capability," said Jensen adding that not much is lost in the transmission. "This machine is almost better than the actual film, because of the windowing capabilities," Jensen continued. "We can make allowances if the technologist has over or underexposed the film. We can't do that with hardcopy film." By making those minor adjustments on the screen, they don't have to expose the patient to more radiation or make another film, which saves money.

Doctors have the ability to annotate directly on the screen and send the image back to where it came from or send it to another hospital. "We can also completely invert the image so that what was black is now white and vice versa," said Jensen. "It distorts the mind's image of what a bone should look like and the provider may be better able to pick up a subtle fracture.

"This is not alien to the radiology community. CAT scans, MRIs, and ultrasounds all come up on screens like these and we're familiar with manipulating the screen image to get the picture we want to look at."

One part of telemedicine is the satellite phone hookup. They were able to get through by satellite phone to the carrier which is deployed in the Indian Ocean. CAPT Robert Sprigg, commanding officer, came on the line and expressed his admiration for telemedicine.

"I can say that from an operational viewpoint, our experience has been positive. We've evaluated over 33 patients and avoided sending at least 12 off on medevacs, which not only saved money, but also keeps my readiness higher," said Sprigg.

Dalton then asked Sprigg to expand on what this technology has done for him in preventing medevacs and keeping up readiness. "We cannot bring all the specialists we need when we deploy," said Sprigg. "With us as the center hub, we can provide not only our ship, but the entire battle group or any ships in the vicinity with immediate consult capability. That's tremendous expansion of our abilities here."

Another part of the system is teleconferencing. Two hookups were demonstrated, one in Zagreb, Croatia, the other Guantanamo Bay, Cuba. The video screens were a bit fuzzy, but the audio was crystal clear. Broadcasting quality video is transmitted at 92 million bits per second. This video was transmitted at 56,000 bits per second, which is quite a drop. Emerging technology may allow improvement in the future.

The case in Zagreb dealt with an Egyptian army colonel who had taken a mortar round in his leg. Lawrence said there was the possibility the man could lose the leg. "Using telemedicine capabilities between Zagreb and San Diego they were able to stabilize the patient and perform a bone lengthening procedure."

"The patient had lost approximately 15 cm of bone out of the femur," said CAPT Gregg Parker, commanding officer of the Zagreb hospital. "The problem was how to replace lost bone." They used telemedicine to transport the images of X-rays to San Diego. "The bone transport system was sent from San Diego and we transported part of the femur that was left to bridge the gap," said Parker. "We expect to be able to salvage the entire extremity, which otherwise may have resulted in an above the knee amputation." All this was done without transporting the patient anywhere.

"Because of telemedicine and good communications, this man has two extremities and will be completely functional, once fully recovered," concluded Parker.

"Great job," said Dalton. "I think it shows the great value of this new technology and I am pleased to see that you and your people are using it to its maximum capability."

The conversation then shifted to CAPT George Gibson, commanding officer, Naval Hospital Guantanamo Bay, Cuba. "We just got the telemedicine on board when the USNS *Comfort* (T-AH 20) left here last month," said Gibson. "We've been using it to talk to ships at sea and I think its helping both of us."

"It's almost mind boggling what this can do to enhance the medical care for our deployed sailors and Marines," said Dalton. "I'm pleased to hear how you have used it already."

It's fine that we can converse and see doctors in other parts of the world and understand them. But what about talking to people who don't speak English. Yet another facet of telemedicine is the medical translating system. It was developed by a physician at the Naval Aerospace Operational Medical Institute in Pensacola, FL.

CDR Michael Greenauer, Navy Medical Information Management System, demonstrated the machine. "The provider, nurse, or even patient selects a phrase from the screen. The machine then speaks the phrase in the particular language chosen," said Greenauer. "All the questions have been designed to be yes/no, pointing movement or instructional issues for the patient, like roll over." The voice came out very distinct and clear.

The system has the capability of 30 languages. "The Public Health Service has also asked the designers to add the Navaho language for those caregivers who deal with the Indian reservations," said Greenauer.

When the demonstrations were finished, Secretary Dalton gave a few closing remarks. "This has been an exciting day for me to see this new program," said Dalton. "I think telemedicine has great potential. We've seen three places where our sailors and Marines are performing. I want to commend you VADM Hagen and your people for the fine job you've done and the success of this project. You have my complete support as we go forward." ❑

CDR Dave Lawrence (left) and CAPT Donald Jensen discuss a hand fracture as the X-ray appears on the screen.

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Casualty Care in "Over-the-Horizon" Amphibious Operations Requires Contingency Options!

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Amphibious operations are the most complex of military operations, and logistic support requirements, including medical care, are an integral part of them. In the Pacific theater during World War II, beginning with the first U.S. landings at Guadalcanal in August 1942, the Marine Corps and Navy labored to confirm and refine their doctrine for both troops and naval components within an amphibious attack force. Similar landing force doctrine, organization, tactics, and techniques were used in the prosecution of Army amphibious operations against the Axis powers in Europe, starting with the landings in French North Africa in 1943. Early operations in both theaters highlighted the enormous difficulties associated with providing essential medical elements, and it was not until late 1944 and 1945 that these problems were adequately solved.

An amphibious assault launched by any naval expeditionary force against a stubborn well entrenched adversary will inevitably produce a large number of casualties among the landing force. In fact, of the many forms of combat assault, amphibious operations have historically suffered the highest casualty rates! Tactical activity profiles of U.S. Army and Marine Corps divisions in World War II, for example, demonstrated that the highest rates of wounding occurred in opposed over water assaults designated as "beachhead operations." The average wounding rate of 11.04 per 1,000 men a day was seven times greater than the average rate for a division in combat in World War II. This was more than twice the average rate for practically all other types of action, including offensive breakthrough operations, reduction of ports and towns, assaults on fortified lines, and river crossings. Casualty rates as high as 25 percent of landing force personnel have occurred in certain highly contested amphibious operations, such as the Battle of Betio on Tarawa in 1943.

The highest casualty rates usually occur during the critical assault phase of an amphibious operation. Unfortunately, this is also the time when medical services have a minimum number of personnel and facilities ashore. Other than the support provided by medical personnel organic to combat units, the options for medical care are limited. Unfortunately, large numbers of casualties ashore may impede an operational undertaking. In the early phases of an amphibious assault, therefore, priority must go to development of a continuum consisting of early forward medical care supplemented by retrograde evacuation to casualty reception facilities within the afloat expeditionary task force.

Fleet medical support is complicated, however, by the fact that new weapons, new communications technology, and new forms of assault vehicles will favor "over-the-horizon" (OTH) amphibious assaults in the years ahead. This assault concept

provides protection of amphibious task forces from the increasingly threatening weapons of potential adversaries, while simultaneously providing greater tactical latitude for "stealth" insertion of landing forces. The OTH concept recognizes the 250 nautical mile range of antiship cruise missiles, as well as extensive shallow and deep water mining capabilities out to the 100 fathom curve—originally developed by Soviet technology and subsequently sold worldwide. Consequently, expeditionary task force support ships may be required to stand out many miles from shore. These distances present a significant challenge to any system for evacuating sick and wounded members of the assault force back to the amphibious task force (ATF).

Since the Korean War, the helicopter has been the predominant mechanism for military casualty evacuation. Notwithstanding the fact that our last "opposed" amphibious operation was the assault upon Inchon during the Korean War, will ready evacuation of casualties by air be assured in the years ahead? In the face of modern antiaircraft defenses, including ubiquitous, highly effective light shoulder-fired heat seeking missiles, the survival of helicopters on the modern battlefield is not guaranteed. Furthermore, the Marine Expeditionary Unit's (MEU) composite squadron has only a finite number of helicopters. These may be unavailable because of other prioritized tactical missions, enemy air superiority, bad flying weather, or other technical constraints. These eventualities may consequently diminish medical evacuation capabilities. The precarious state of the MV-22 (Osprey) project makes the issues of future casualty evacuation capabilities and options ever more tightly constrained.

The battlefield of the future may therefore be too lethal for evacuation of the wounded exclusively by air. As a result, assault echelon casualties may be immobilized for hours without adequate medical attention. Without the institution of early medical treatment (an extremely "time-sensitive" reality), some unstable casualties may die. Others, with relatively minor but infected injuries, may suffer conversion of their wounds into seriously complicated disabilities, thereby preventing their timely return to duty. Alternative contingency means for efficient casualty management are obviously needed by operational commanders, and provision for surface evacuation of casualties to the embarked task force may consequently assume greater importance.

Mandate for the Future

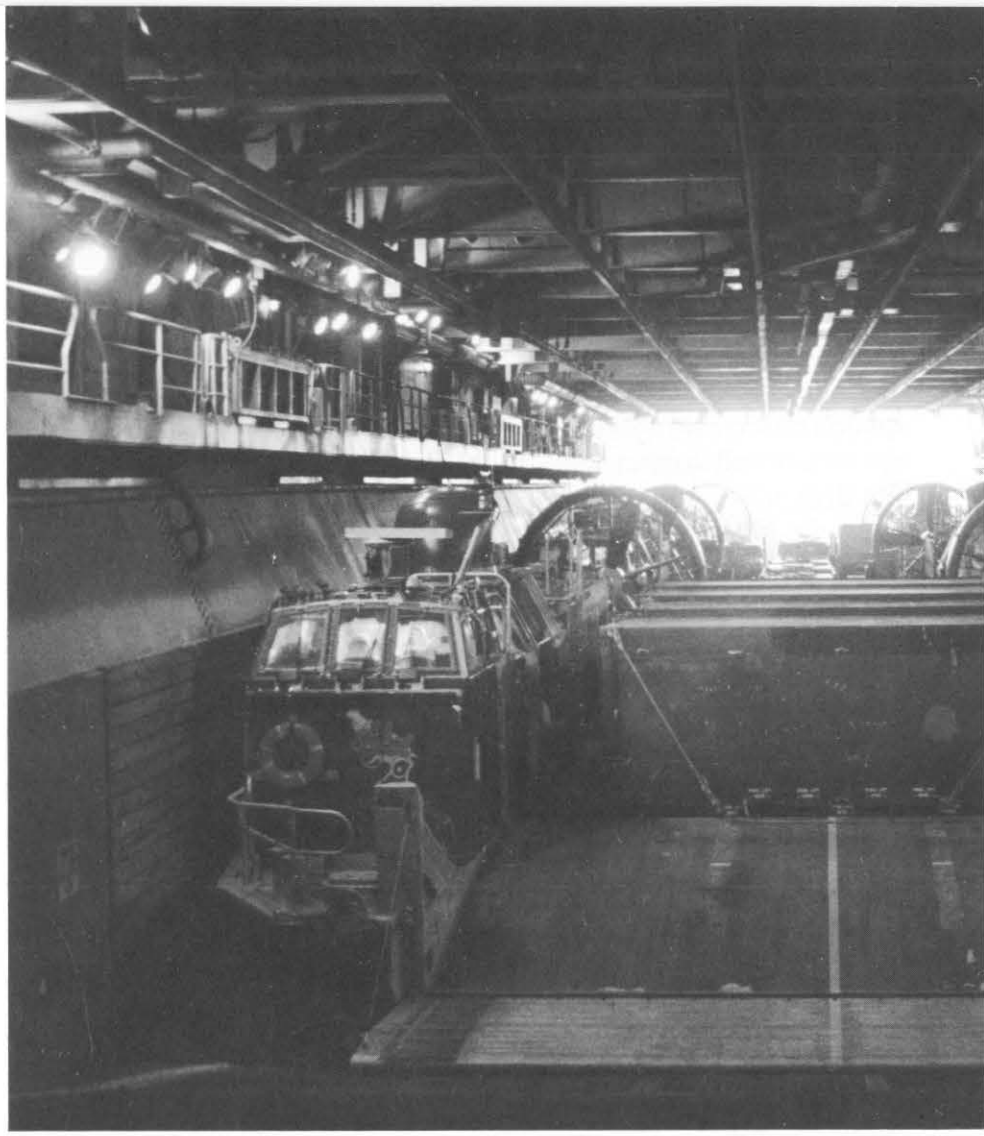
Old fashioned heavy reliance upon extended "nonselective" evacuation chains back out to the amphibious task force, for all classes of injury, was characteristic of attrition warfare. In a modern context, however, it is unrealistic! Not only does a lack of selectivity in evacuation of casualties impose an enormous burden upon transportation assets and casualty reception facilities within the fleet, but the heavy logistic requirements are anathema to the concept of tactical mobility. Furthermore, it must be understood that merely entering the injured into an overburdened evacuation chain does not provide relief or guarantee survival for a wounded Marine who may be bleeding to death. *Consequently, it remains incumbent upon the Marine Corps and Navy to articulate an up-to-date comprehensive casualty management plan, including multiple contingency medical support options, for the setting of high speed maneuver warfare supported by an OTH naval task force.*

There must be a more realistic upgrade of tactical medical support options. More intensive formalized study of the art and science of far forward tactical medical support is required. This mandate should also stimulate the development of easily transportable light surgical units for far forward stabilization of the unstable injured (as was carried out by the Israelis during the Yom Kippur War of 1973), and a medical capability on the beach which can selectively sort out for further retrograde evacuation only those with no hope of an early return to duty. Heavy dependence upon conversion of ground, air, and maritime surface assault vehicles for casualty evacuation is not a realistic option without the addition of these far forward surgical stabilization assets, and more selective retrograde evacuation of only the most seriously injured.

An option exercised during World War II amphibious operations, as well as subsequent landings at Inchon, Korea, was conversion of the tank landing ship (LST) into an important forward component of the medical care system. LSTs modified for surgical support, although of limited capacity, were reconfigured for use by surgical teams to provide the wounded with quick, early, lifesaving or stabilizing treatment in forward locations.

During the 1944 landings at Leyte Gulf, the benefit of having surgical team LSTs beached after unloading was demonstrated. Commanders learned the value of holding one or two surgical LSTs in reserve, awaiting demand either at beaches overwhelmed with casualties, or at those left without medical facilities. During the operation at Lingayen Gulf in January 1945, six LSTs with embarked surgical teams were beached to provide casualty care.

At Normandy, all LSTs were equipped to handle returning casual-



A MCESS loaded on LCAC deck.

ties, and 54 were equipped to perform surgery. One was even outfitted as a floating blood bank. Such hospital LSTs, able to provide sophisticated surgical care in a relatively safe environment close to shore, received their major successful test under fire at Iwo Jima and Okinawa.

As is well known, however, the LSTs will soon be withdrawn from active duty within the fleet. Other options are required!

Landing Craft Air Cushion (LCAC)

Landing Craft Air Cushion (LCAC/MCAC) vehicles are highly maneuverable multipurpose hover craft designed to conduct over-the-horizon ship-to-shore movements of assault vehicles, troops, and supplies. Their high speed assault capability, incorporating the ability to transit easily the land-sea interface, has identified them as vital components of the OTH concept of operations. The LCAC is an ideal assault vehicle for accomplishing tactical surprise and the swift introduction of amphibious forces, while maintaining the lower profile required for staging night assaults from 25-50 nautical miles (NM) offshore.

Loaded and traveling toward a beach at 40 knots (depending upon the sea state), and returning outbound and empty at 50 knots, has been the LCAC's optimally defined capability. When delivering an amphibious assault element, two sorties per LCAC, to be completed within 90 minutes over a distance of 50 NM, are considered realistic in calculating their utilization as ship-to-shore assets. Given total load, marshal, and unload time of 30 minutes for each LCAC sortie, it has generally been anticipated that these vehicles will be totally committed during this period of intensive operations. Additional LCAC contingency capabilities, however, could be utilized during these ship-to-shore movements.

During a 1993 deployment to the Arabian Gulf and West Indian Ocean (CARG 2-93) on board USS *Wasp* (LHD-1), the LCAC was utilized to conduct various unique operations, including extended on station evolutions, diving operations, and cargo transport. (A total of 29 million pounds of rolling stock was transported via LCAC.) Mass casualty drills were also conducted, with rapid retrograde LCAC transport of casualties as well as evacuation of noncombatants/refugees back to the ATF from beach embarkation sites.

LCAC in the Casualty Care Continuum

The LCAC would appear to be an excellent platform for retrograde transport of casualties from an evacuation landing site, especially during adverse weather such as morning fog, severe thunderstorms, the restrictions of night operations, or severe beach gradients. Unfortunately, it has no internal capability to evacuate stretcher casualties, and only a limited (24-patient) ambulatory patient capacity within the craft's troop compartments.

The outer deck of the craft is unsuitable for direct carriage of casualties because of the dangers of high winds from the massive propellers, excessive noise, high temperatures near the exhaust stacks of 800°F,

Below: **An LCAC in action**

Textron Marine Systems

and—in the case of operations within cold climates—exposure.

The LCAC design allows for rolling stock and tracked vehicles to be loaded and unloaded across its forward and aft ramps. Combining the LVTP-7 amphibian tractor with the LCAC has been proposed as one alternative for increasing casualty transport capability. Two LVTPs, bearing six stretcher casualties each, may be loaded at a forward battle area, moved directly to a beach evacuation station, and then driven aboard an LCAC for further transfer to any casualty receiving and treatment ship with a well deck.(*1*) Likewise, an LCAC may accommodate nine M997 (HMMWV) ambulances, each capable of carrying either four litters or eight ambulatory patients.(*2*)

Enclosed Shelters: the MCESS Option

Another simple proposed solution to LCAC casualty conveyance is the amalgamation of the LCAC with an enclosed shelter, either a collapsible or rigid-type container, placed on board the craft's main deck space. One option is the Marine Corps Expeditionary Shelter System (MCESS), a collapsible shelter designed to replace or augment general purpose tents in logistics facilities ashore, such as maintenance shops, electronics workshops, or certain field medical facilities. During several operational evolutions aboard USS *Wasp* amidst its East African deployment, the MCESS was used to expand the operational capability of the LCAC. It proved to be an excellent adjunct for the protected transport of combat loaded troops, and a stable platform for personnel evacuation operations. The MCESS provided a safe, dry, and workable environment for medical and escort personnel. During a total of 288 beach landings, a total of 5,720 passengers were transported via this protected LCAC conveyance.

MCESS collapsible shelter/containers can be preassembled on board amphibious ships. The setup time for a MCESS is approximately 15-20 minutes, and can be accomplished by an experienced crew of 20 people. Aboard a *Wasp* class LHD ship, the assembly may be accomplished in the upper vehicle stowage area as the well deck is being cleared of vehicles during the assault phase of an amphibious operation. The MCESS shel-

An LCAC maintenance team assembles MCESS shelters. These shelters were modified with air ducts and lighting. *Opposite page:* Loading Air Force 8-foot x 8-foot capacity pallets aboard LCAC.

ter weighs about 2,500 pounds. Using container handling equipment, it can be rapidly loaded aboard an LCAC following its return from the initial assault wave, and then used to transport additional combat troops. During amphibious operations, the use of a single 20 foot x 8 foot x 8 foot MCESS shelter would accommodate the transport of 30 combat loaded troops. A single MCESS would require 4 of the 13 vehicle spots on the main deck, but increase the total troop capacity to almost 90 combat troops per LCAC load (30 in MCESS, 20 in the LCAC cabins, and 36 carried in 9 "hard top" vehicles secured to the main deck).

After landing at the beachhead and discharging its load, the LCAC generally returns to the host ship for either more troops and vehicles, or to await further tasking. If MCESS shelters were employed for the forward transport of assault troops, they would be empty on most return trips. They could, therefore, perform a secondary mission of rapid casualty evacuation. The LCAC/MCESS combination could be used, in retrograde movement, to provide shelter for either walking or stretcher confined casualties returning to the casualty receiving and treatment ships. It would provide protection from weather and noise while furnishing an area for treatment during evacuation. (Indeed, up to six MCESS shelters may be staged across the LCAC deck (athwartships) for carriage of "walking wounded," or the deck stowage may be reconfigured to allow four shelters to facilitate transport of litter-borne casualties.)

Each MCESS, with minor modifications, would be available to transport 30 "walking wounded" plus medical attendants. Adapting the MCESS to litter carriage would require only a modest reconfiguration. For example, in its standard configuration the MCESS will allow for the movement of only nine litter casualties. With this number of patients placed on the deck, all available space is completely covered. It does not allow for monitoring of patients within the shelter during transport. A potentially useful modification to the MCESS design involves the mounting of helicopter litter support straps, similar to those used in CH-46 and CH-53 helicopters, from the bulkheads and the overhead on three sides. This would increase the MCESS litter carrying capacity to 15. These straps would fold up inside when not in use, and not obstruct its overall troop carrying capacity. This modification, however, would allow stretcher-borne casualties to be placed three high, and provide a walkway down the center 3 to 4 feet wide. If standard canvas stretchers were used, and patients were tended by medical personnel in transit, it is estimated that the added effect upon cycle time per troop load would be less than 10 minutes.

Additional modifications within the MCESS could include the installation of plug-in jacks, allowing medical attendants to wear crew helmets and have virtually hands-free internal communications with the LCAC crew. Also, MCESS currently has a lighting system requiring 110v, 60Hz, although not all LCACs contain power converters for this use. A small portable generator, already existing in the USMC equipment T/E, would solve this problem. Placed behind the MCESS, it could continue to run even when the craft is under way. Heat and/or air conditioning may be accomplished by mounting a small unit similar to that used in civilian motor homes, which would provide adequate air flow within. Operation of this system also utilizes 110v, 60Hz, is simple to install (four bolts and a hole), and has been "road tested" for many years. In addition, "jack-up" wheels are already available for facilitating movement of the MCESS units.

Photos by LT Daniel P. Shaw, USN

Enclosed Shelters—the Personnel Transport Module (PTM)

Research and development efforts have continued with the goal of further augmenting the LCAC role in transporting combat-ready Marines from ship to shore. This has produced newly designed PTM shelter assemblies for use in lieu of MCESS shelters. These are to be secured to an LCAC deck and accommodate between 160 and 180 combat loaded Marines. The PTMs are to be equipped with lighting, controlled ventilation, power supply, acoustic protection, protective armor, integrated communication capability, and aircraft style seating. A collateral function would be the retrograde transport of ambulatory and stretcher-borne casualties from either shore to ship, or from shore to shore.(*3*)

LCAC as a Beachfront Surgical Stabilization Platform

In light of the distances involved in OTH amphibious operations, assault echelon casualties may be immobilized for hours without adequate medical attention. Consequently, it may be necessary to rapidly transfer ashore, earlier than we do now, an efficient and discriminating advanced medical capability. The inclusion of a small LCAC mounted medical/surgical treatment team in the first waves of an assault is a command option that would allow for initial on-site care and treatment of wounded. Its mission tailored role would be to stabilize those gravely injured, sort out the light from the heavily wounded, and prepare the latter, selectively, for transfer to the amphibious task force (AFT). The LCAC enhanced with either the Personnel Transport Module, or MCESS shelter(s), could be utilized to strengthen such medical capabilities both during and immediately following the initial phases of the amphibious assault. Supporting such teams with a combination of LCAC mounted MCESS shelters or PTMs, portable electric generators, portable refrigerators, lights and additional security measures along with normal medical supplies, all staged on the LCAC in a dry, safe setting, could potentially serve a very useful personnel-conserving role.

Staging an LCAC mounted triage team at the water's edge, or enroute, would allow early treatment and preliminary sorting of combat casualties when few other medical assets are on the beach. This would effectively increase the efficiency of casualty flow back to the AFT, and prevent the evacuation route from becoming a massive exit conduit of both minimal and seriously injured patients. By offering selectivity of evacuation at the water's edge, those personnel capable of returning to duty would be released back to their units far earlier, thereby conserving landing force manpower resources. The early application of stabilizing treatment

would also prevent uncontrolled deterioration of injuries.

In the event that hostile action develops at its beached location, the LCAC could get under way in less than 2 minutes. Since the LCAC is OTH capable, it could remain out of the range of small arms, and be tactically employed in different areas much farther away than if confined to the original area. The medical team could stabilize the patients while the LCAC conveys the casualties to ships located OTH. This would also ease demand for the limited number of aviation vehicles which cannot always wait for patients to be stabilized. If air transport is available, however, the forward surface medical team could tend to those critically unstable patients until they are in a more balanced physiologic condition for air transport. In short, more immediate care could be given to seriously injured patients, and almost immediate escape could be made by the LCAC if required. Aviation assets could thereby be freed for other missions.

Given the greater distances involved in OTH operations, and the time-sensitive nature of some combat injuries, lives may indeed be saved by either bringing mobile surgical teams forward to casualty evacuation stations, or facilitating rapid retrograde transport of casualties to the ATF casualty receiving platforms. Subsequently, as the tactical situation clears at the beachhead site, a medically and minor surgically augmented MCESS with its generator (or possibly a modified PTM as well) could be deposited by the LCAC on the beach to provide for a rearward BAS, or clearing station, for the holding and transfer of casualties from the front lines to the ATF. Furthermore, by "marrying" two MCESS shelters together, removing the inner bulkheads while retaining the vertical bars, and installing a rubber "T" gasket between the two, a "building" would be created. If the litter straps are retained, it would be large enough to accommodate 30-35 litters (or 70 combat troops). The MCESS can be staffed by a small experienced triage and casualty stabilization team (two to four people) from the casualty receiving and treatment ships, freeing FMF medical assets to continue providing initial battlefield care as combat moves inland.

Summary

In OTH amphibious operations, the extended evacuation route for combat casualties need not become a wide open conduit for evacuation of all gradations of injuries. By providing a mobile forward located facility with advanced medical capability, and the capacity to sort out the lightly injured from the serious nonreturnable casualty, the fighting strength of combat elements may be sustained by early return to duty of minimally injured. On the other hand, expeditious movement of the more seriously injured back to the casualty receiving ships of the amphibious task force, over the greater distances required by OTH operations, can be accomplished with either the PTM or the MCESS modified LCAC platform.

The MCESS proposals would utilize existing assets which are already deployed, and would have a negligible impact upon funding. Both the PTM or medically modified MCESS/LCAC combination, however, have the potential to dramatically increase the efficiency and selectivity of casualty evacuation from the battlefront. Secondary benefits would include accomplishment of preliminary triage while enroute to the CRTS, and freeing critical aviation and other surface assets for other missions.

In light of plans to become a smaller yet more capable Navy, it is incumbent upon us to maximize the utility of our resources. *These proposals should be considered, not as an abrogation of doctrine, but as contingency options for an operational commander, akin to "arrows in a quiver."* They could utilize LCAC and MCESS assets that are currently deployed together, and their impact on funding would be minimal. Regardless of cost issues, however, the potential to provide a dramatic increase in the depth of casualty care, as well as faster triage and treatment for battlefield injuries, while concomitantly freeing surface and aviation assets for other tasking, makes these contingency proposals worthy of further development and testing.

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Naval Medical Research and Development Command and Technology Transfer

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The primary mission of the Naval Medical Research and Development Command (NMRDC) is to provide biomedical research to support the men and women in the Navy and Marine Corps. NMRDC's research areas concentrate on combat casualty care, infectious diseases, diving and submarine medicine, environmental and occupational health, aviation medicine and human performance, military oral health, and bone marrow research. These seven research areas focus on operational medicine, which is occupational medicine practiced in a military environment. Operational medicine is very different from traditional medical care provided at military and civilian hospitals and clinics. Operational medicine specifically addresses the physical readiness, performance, and safety issues of military recruits, special training groups, and personnel in the surface, submarine, air, and amphibious warfare communities.

NMRDC includes a system of strategically located basic-science and technology-based laboratories in the U.S. and overseas. At these laboratories Navy and civilian scientists conduct basic, clinical, and field research. These in-house research efforts are complemented by a contract and grant program with universities and private industry. NMRDC also supports research in other Navy laboratories as well as in partnership with the Army and Air Force and other Federal agencies.

While NMRDC's mission remains the same, the command has expanded in a new direction of technology reinvestment, often called technology transfer, that benefits the Navy and the nations's economy. New commercial partnerships are forming between NMRDC's researchers and their counterparts in the private sector to integrate Navy technological innovations into civilian-use products, services, and internal processes.

To derive maximum return on research dollars, Congress passed legislation in the 1980's allowing the transfer of federally funded technology to the civilian sector. The Stevenson-Wydler Technology Innovation Act in 1980 and the Federal Technology Transfer Act in 1986 opened the doors for strategic alliances between Federal laboratories and universities, nongovernment laboratories, and industry. This compilation of laws authorized Federal laboratories to enter into Cooperative Research and Development Agreements (CRADAs). Federal research assets (other than money) that have application to the civilian community (dual-use) are shared with nongovernment laboratories and industry through CRADAs. These laws are the only statutes that permit Federal laboratories to provide a private partner with protected proprietary information, intellectual property rights, and exclusive marketing rights in advance of final research results. NMRDC has made significant progress in the area of technology transfer through CRADAs. Since 1990 NMRDC's technology transfer efforts have increased and currently there are 40 active CRADAs.

NMRDC's first CRADA was signed by the commanding officer on 24 July 1990. The agreement transferred a cell line developed by Dr. Donna G. Sieckmann of the Naval

Medical Research Institute (NMRI), Bethesda, MD, to Pharmingen for commercial development. The cell line, named DS-1, produces monoclonal antibodies against mouse IgM^a, producing a key reagent for immunoglobulin test kits. Pharmingen, a California-based corporation, provides biological test materials and monoclonal antibody tests to the public. In return for the use of the DS-1 cell line, Pharmingen pays NMRI a fee based on sales of monoclonal antibody test kits.

In March 1994, an NMRDC Technology Transfer Advisory Board and Working Group was formed to work closely with the in-house laboratories to consolidate, promote, and market technology transfer efforts through an outreach program to industry. As a way to continue developing interactions between private industry and NMRDC, members of the advisory board have teamed with the Stennis Space Center, NASA, Marshall Flight Center, the Gulf Coast Alliance for Technology Transfer, and Martin Marietta Manned Space Systems to provide seminars at various corporations throughout the country. In addition, NMRDC involvement with the Office of Naval Research's Industrial Programs Divisions (IPD) resulted in a $50,000 grant to NMRDC to support new initiatives in marketing NMRDC technologies.

Other more traditional technology transfer efforts include networking through attendance at professional meetings, presentations, publications, external scientific peer review, use of contractor technical personnel at NMRDC laboratories, Small Business Innovation Research (SBIR) programs, and contracts and grants to the civilian sector. NMRDC's activities in these areas include more than $8 million annually in civilian sector extramural contracts and grants, and more than half a million dollars in SBIR. CRADAs and establishment of intellectual property remain the core of NMRDC's technology transfer efforts. In the future NMRDC will implement Navy policies for technology transfer in ways that are innovative and adapted to Navy medical research and development and support the mission of this command. ❑

CAPT Patee is Commanding Officer of the Naval Aerospace Medical Research Laboratory in Pensacola, FL. CDR Mittelman is assigned to the same facility. CDR Dolgin is assigned to the Naval Biodynamics Laboratory in New Orleans, LA.

Highlights of NMRDC Technology Transfer Partnerships

NMRDC has negotiated several CRADAs with research foundations, corporations, and universities to pursue specific projects. These agreements recognize the dual use of NMRDC research and turn Navy-generated results into commercially usable products and processes. All these agreements are designed to further advance and benefit the mission of NMRDC and positively impact the country's economic growth through technology transfer. Below are just a few examples of the successful NMRDC technology transfer partnerships.

Naval Aerospace Medical Research Laboratory, Pensacola, FL
University of Illinois (Completed)

Goal: To develop data and information about the effects of fatigue and sleep deprivation on human capabilities concerning information processing.

The University was able to complete the research concerning fatigue effects utilizing equipment and test subjects at the Naval Aerospace Medical Research Laboratory, while the laboratory was able to complete its own separate research project utilizing computer services from the University.

U.S. Naval Medical Research Unit No. 3, Cairo, Egypt
Merck and Company, Inc. (Completed)

Goal: To research, develop and evaluate Merck's formalin inactivated alum-adjuvanted hepatitis A vaccine, and to perform a clinical research study. The Navy successfully evaluated the vaccine's capacity to inhibit the activity or infectivity of hepatitis A in U.S. military populations.

Naval Dental Research Institute Detachment Bethesda, MD
LifeNet (Completed)

Goal: To compare the amount of bone formed using two different particle sizes of demineralized freeze-dried bone allograft. The CRADA partner provided materials and advice; the Navy provided data and results.

The research supported the education and training of Navy dentists and improved periodontal patient care for all forces of the United States.

Naval Medical Research Institute, Bethesda, MD
Futrex, Inc. (Completed)

Goal: To investigate the feasibility of a noninvasive instrument that uses transdermal near-infrared spectroscopy for monitoring percent body fat and total water.

The research resolved the correlation between percent body fat as determined by hydrostatic underwater weighing and as determined by the Futrex instrument. NMRI researchers tested the efficacy and helped to calibrate a new piece of equipment developed by a local small business.

Naval Medical Research Institute, Bethesda, MD
Repligen Corporation (Current)

Goal: To develop improved techniques to modify and regulate lymphokine gene expression in order to enhance the recovery of a damaged immune system or to improve the response to vaccines.

A transgenic mouse was developed that may be a useful tool in research of diabetes. The basic underlying research related to CD28 and CD4 is protected by patent applications filed by the University of Michigan. The research is showing interesting and useful results which may develop into a highly valuable commercial product to be developed by Repligen. Additional patent applications are being prepared and another, related CRADA may develop.

U.S. Naval Medical Research Unit No. 3, Cairo, Egypt
The Bioanthropology Foundation (Current)

Goal: To develop and study information on the biology, distribution, and risk factors associated with poisonous snakes indigenous to Egypt.

The commanding officer of the U.S. Naval Medical Research Unit No. 3 noted that the first question asked during Operation Desert Storm was not about general diseases or the like, but related directly to encountering scorpions and poisonous snakes. The research and assistance under this CRADA will help accurately answer that question for North Africa in the future.

Naval Medical Research Institute, Bethesda, MD
Genelabs Technologies, Inc. (Current)

Goal: To study and develop information about the epidemiology, immunology, and molecular biology of the hepatitis E virus.

At least one patent application has been filed by the CRADA partner naming a Navy co-inventor. Under this ongoing collaborative research a test for identifying hepatitis E has been developed and successfully used by the Navy in the Desert Storm operation area. Materials developed by the Navy have been turned over to the company for commercial development. Work is going forward in collaboration with CDC and the company to develop a hepatitis E vaccine.

Naval Aerospace Medical Research Laboratory, Pensacola, FL
Otis Elevator Company (Current)

Goal: To investigate the physiological responses to a variety of acceleration profiles encountered in high speed, large displacement elevators. This is an ongoing collaboration in which researchers at NAMRL are using equipment at Otis to develop acceleration profiles.

Naval Health Research Center, San Diego, CA
Symtonic (Current)

Goal: To investigate the value of the electromagnetic sleep induction device (LEET) for facilitating sleep in subjects who must work after shifting time zones or are moved from the day to the night shift.

The relative and combined value of LEET and timed bright light exposure for shifting the sleep/wake cycle and improving quality of sleep and performance are to be determined.

Naval Biodynamics Laboratory, New Orleans, LA
Snell Memorial Foundation (Current)

Goal: To analyze human dynamic responses to impact acceleration and to determine the correlation of these responses with injury potential. The results of these analyses are expected to be applicable to the design, construction, and validation of mathematical models of human impact responses.

This is an ongoing collaboration where the laboratory makes available records of tests to a recognized testing and rating laboratory. The data are being used to develop better standards for testing motorcycle helmets and other types of helmets.

Naval Medical Research Institute, Bethesda, MD
Genetic MediSyn Corporation (Current)

Goal: To design and investigate the protective effects of antisense molecules against the inflammation associated with septic shock in cell cultures, animals, and human subjects.

Several patent applications have been filed as a result of this collaborative research, naming both corporate and Navy coinventors.

Naval Medical Research Institute, Bethesda, MD
Cellco, Inc. (Current)

Goal: To develop technology that will permit *in vitro* culture and expansion of human hematopoietic progenitor cells. A specific culture system will be tested for the ability to rapidly and significantly expand human hematopoietic stem cells for use in clinical situations such as autologous bone marrow transplantation and gene therapy.

Navy Medicine
January-February 1945

Joseph Frechette

The first 2 months of 1945 saw the continued advance of the Allied forces on virtually every front while the exhausted Axis Powers gasped and sputtered their way toward defeat. Germany was on the verge of collapse. By February the Soviets had advanced to the Oder river preparing for the final push toward Berlin.(1) Meanwhile, the Allies had driven to the Rhine and were making ready for Eisenhower's broad offensive that would carry them to the Elbe.(2)

In the Pacific, America's island hopping campaign would continue with the landings on Luzon, the liberation of Manila, and the invasion of Iwo Jima. The Japanese resisted grimly and counterattacked with their fearsome kamikazes. However, with clear-cut naval superiority due to America's vast industrial output and the severe losses the Japanese had suffered at the Battle of Leyte Gulf, the American forces closed in on the Japanese home islands.

The Big Three—President Roosevelt, Prime Minister Churchill, and Premier Stalin had their last meeting in early February. At the fateful Yalta Conference they attempted to hammer out a plan for postwar Europe and Roosevelt tried to convince Stalin to join in the war against Japan. At the time everyone still believed it would take the invasion of the Japanese home islands to bring Japan to its knees and Russian support was considered to be a great asset.

The Philippines Campaign Continued

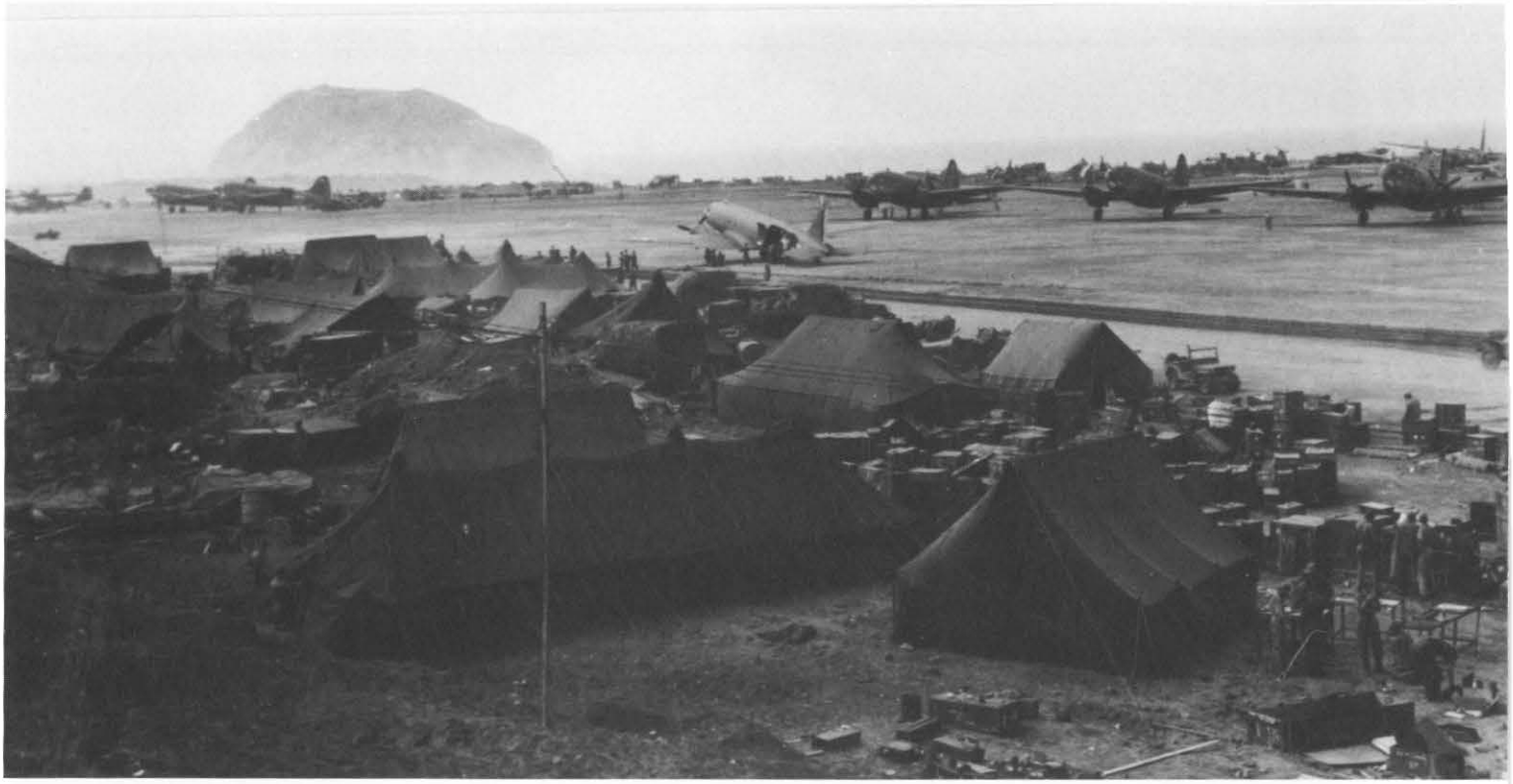
The landings on Luzon commenced 9 Jan when GEN Walter Krueger's Sixth Army hit the beach at Lingayen Gulf with four divisions. Naval bombardment had begun 2 days before supported by the active Filipino rebels who harassed the Japanese throughout the island. By nightfall a beachhead 15 miles wide and 6,000 yards deep had been established and 68,000 troops landed.(3) The tactics chosen by the Japanese commander GEN Tomoyuko Yamashita meant the United States suffered few casualties during the initial landings. Yamashita had decided to adopt an inland static defense to delay the conquest of Luzon as long as possible.(4)

Reports that the Japanese might massacre the POWs held at various prison camps throughout Luzon led to some spectacular rescue operations. In January the 6th Ranger Battalion liberated the prison camp at Cabanatuan in a daring raid behind Japanese lines. American forces then freed the civilians and 11 Navy nurses interned at Los Baños on 23 Feb. The rescue operation at Los Baños was a combined airborne and amphibious assault made with the assistance of an escapee, Pete Miles, and Filipino guerrillas. LT Dorothy Still, NC, recalled the entrance of the rescuing forces:

"An amtrac pulled up in front of the hospital and the American troops jumped out. Oh, we had never seen anything so handsome in our lives. These fellows were in camouflage uniforms wearing a new kind of helmet, not those little tin pan things we were used to seeing. And they looked so healthy and lively."(5)

American forces entered Manila on 2 Feb and the next day released 3,500 internees from Santo Tomas University. On 4 Feb, after a brief firefight, troops liberated 1,300 starving Allied POWs from Bilibid prison. For many of the prisoners this was their first taste of freedom since the surrender of the Allied forces at Bataan and Corregidor in the spring of 1942.(6)

In a scorched earth retreat that left Manila in ruins, the Japanese resisted



With Suribachi as a backdrop, transports wait to evacuate the wounded to a hospital on Guam.

ferociously in house to house fighting and it would not be until 4 March before the city was finally declared secure. Throughout the island the Japanese fought staunchly and although their forces were driven back into isolated pockets many refused to surrender until the end of the war.(7)

Navy medical participation was largely limited to immediate treatment and evacuation in the early phase of operations while the Army took responsibility for hospitalization and later evacuation. Navy medical personnel from APAs went to the beach to administer additional first aid to casualties brought in by Army medical personnel and to screen patients for evacuation. Cases in immediate need of surgery were sent aboard surgically equipped LSTs while more lightly wounded patients were evacuated directly to the APAs.(8)

Medical treatment and evacuation on the beaches was facilitated by the presence of five surgically equipped LSTs. Four stayed on shore to provide treatment and to collect cases for evacuation while the fifth stood offshore in reserve. Each was equipped with about 50 bunks and had emergency operating facilities. Treatment was eased by the light casualties suffered on the beaches and some corpsmen even had time to assist in unloading cargo. The surgical LSTs unloaded their cargo and remained on the beaches until Army medical facilities had been set up ashore. In addition to their usual complement they were staffed with two additional surgeons and five additional corpsmen. When a surgical LST needed to reduce its casualty load it simply withdrew from the beach and unloaded onto an APA or APH.(9)

The Army supplied the surgical LSTs with whole blood as well as 20 million units of penicillin and additional gas gangrene antitoxin. LST-464, acting as a blood bank, supplied the APAs with 400 pints of blood. Further blood supplies were flown in from the United States.(10)

Much more serious than the casualties suffered on the beaches was the devastation wrought by the kamikaze attacks on the U.S. task force. Fortunately, the attacks ceased after 13 Jan because the Japanese had decided not to replace the planes they had lost. In actions around Mindoro and Lingayen from 13 Dec through 13 Jan, 20 ships were sunk, 24 heavily damaged, and 35 lightly damaged.(11)

A kamikaze struck USS *Manila Bay* (CVE-6) on 5 Jan directly above the sick bay. Although many medical personnel were injured, they continued to function and set up a new sick bay in the forward battle dressing station. Another suicide plane struck

the superstructure of the USS *New Mexico* (BB-40) killing 30 and wounding 129. Unfortunately the casualties could not be evacuated for the next 13 days. On 6 Jan USS *California* (BB-44) was struck and one of its own 5-inch shells exploded resulting in 203 casualties. These were augmented the following day by the addition of 52 casualties in need of medical care from three other ships.(12)

Treatment of battle injuries aboard ship had become relatively standardized by this time. In order to better deal with the kamikaze threat medical supplies were distributed throughout ships in metal cases. After medical personnel applied first aid they debrided wounds and applied sulfanilamide powder and sterile dressings. More and more often casualties were administered type O blood during transfusions in place of plasma.(13)

Recommendations were made for greater numbers of cots, increased plasma allowances, use of protective clothing, and even leaving the hair long to help reduce the risk of head trauma.(14)

The Hell Ships

On 13 Dec a work draft of 1,619 men from Manila's Bilibid Prison had embarked on a disastrous journey to Japan. The Japanese were trying to evacuate the prisoners before the arrival of Allied forces in the Philippines. They were to serve in forced labor camps in Japan and Manchuria. The draft included Medical Corps personnel from Bilibid under CDR Thomas Hayes. Conditions were horrific, the prisoners' rations were far from adequate, and the conditions in the holds they were traveling in were overcrowded and unsanitary. The two ships carrying those that had survived since leaving Manila put in at Takao, Formosa, on 31 Dec. This was to be a tragic layover and many would not leave the port alive. On 6 Jan the Japanese transferred the approximately 200 surviving men in the hold

Photos from BUMED Archives

Far left: **Whole blood flown from the United States goes aboard a transport at Guam for a rapid return to Iwo Jima . . . . . where corpsmen transfuse it into a wounded marine.**

of *Brazil Maru* to *Enoura Maru* to join the approximately 1,000 men in that ship's holds.

Since arriving in port the prisoners' rations had improved somewhat but were still far from adequate. Sanitation consisted solely of horse troughs, and none of the POWs wore proper clothing for the more northern latitudes they had entered since leaving the Philippines.(15)

The Japanese opened the forward hold the following morning to ease the overcrowded conditions. Five hundred men were moved forward from hold number two including CDR Hayes and most of his medical staff. On the morning of 9 Jan an American air raid attacked the dock area. *Enoura Maru* drew the attention of the American pilots as it was tied up alongside a Japanese destroyer. One bomb exploded alongside *Enoura Maru* wrenching the bulkheads between the two prison holds. A second bomb exploded directly in the forward hold killing about 250 and wounding the rest. CDR Hayes and nearly all the doctors and medical personnel were killed by this blast. Another bomb landed aft and sent hatch planking crashing down on top of the prisoners there, killing about 40 and pinning 80 under the debris.(16)

The Japanese refused to allow the wounded to be sent ashore for treatment nor did they allow the prisoners to receive medical supplies. A portion of the hold was set aside to serve as a makeshift hospital. The dead were stacked up under the hatch but the Japanese prevented the bodies from being removed for 4 days. Surviving doctors and corpsmen continued to care for the wounded despite their own injuries until many dropped from exhaustion. Some even died in their sleep.(17)

The Japanese transferred the remaining prisoners on 13 Jan to *Brazil Maru*. By this time the 800-900 men still living were so weak that 12 died during the transfer. As they continued north toward Japan the weather became bitterly cold. The scantily clad men began suffering from chills and pneumonia; 47 died during the first day at sea. In addition the Japanese still provided food and water in insufficient quantities. By the time the ship docked at Moji, Japan, the death toll had risen to 40 men a day including the senior medical officer, CDR Maurice Joses. Only 425 prisoners were left alive. Of these 235 more would die in prison camps in the next 6 weeks and 80 more in a local hospital! Only a few would survive the war.(18)

Navy Medicine at Yalta

The conference between the "Big Three" took place 4-11 Feb. Yalta was chosen as the site for the summit because Stalin was determined that it should be held on Russian soil and it was the only place in the Soviet Union not vetoed for health reasons by Roosevelt's physician Surgeon General VADM Ross T. McIntire. However, before the conference took place there were details that required attention.

On 3 Jan the medical department of USS *Catoctin* (AGC-5) received orders to make the Crimean conference site at the Czarist Livadia estate habitable for about 300 people. Soviet troops had just liberated the Crimean peninsula from the Nazis and the facilities were in deplorable condition. *Catoctin* transited the Dardenelles and Bosporus on 21 Jan, becoming the first Allied vessel to enter the Black Sea since the beginning of the war.(19)

After assessing the situation the Medical Corps personnel constructed latrines, chlorinated the water supply, provided the maids with disinfectant, inspected the food, and exterminated insects. The sick bay was so efficient that the British delegation asked for and received aid from the Americans.(20)

Iwo Jima

On 19 Feb 1945 the Fourth and Fifth Marine Divisions landed on Iwo Jima; the Third Marine Division was held in reserve and landed 2 days later.(21) The bloody battle was fought so the B-29 superfortresses returning from their bombing missions over Japan would have a base to make emergency landings if they couldn't make it back to their home airfields in the Marianas. Iwo Jima would also provide a base from which escorting fighters could operate. At the end of the first day's fighting the Marines had cut the island in half but had already suffered 2,420 casualties.

On 23 Feb Marines took Mount Suribachi in the south of the island, and PhM2c John H. Bradley helped raise the second American flag flown from the summit thereby gaining immortality. The photograph by Joe Rosenthal of that event is one of the most widely known pictures of the war and served as the model for the Marine Corps Memorial in Arlington, VA.(22)

Four medical shore parties landed by H-hour-plus-120 minutes and other medical units came ashore as rapidly as possible. The ferocity of the fighting made treatment difficult. Corpsmen often had to work in shell craters and foxholes while dodging incoming fire.(23) Due to the extreme number of casualties many of the hospital sections of the medical companies that had landed to support the regimental combat teams simply stayed on the beach to assist with evacuation until division and corps hospital installations were functioning. Despite the intensity of the fighting and a casualty rate in excess of 1,000 per day for the first 21 days of the operation, casualties were evacuated as quickly and efficiently as possible. By D-day-plus-33, 17,677 casualties had been treated and evacuated.(24)

Casualties among corpsmen were extremely high; 38 percent of the corpsmen with the Fourth Division were injured. Medical companies furnished replacements but, contrary to established doctrine, in some cases were depleted too severely to render proper care to the wounded once they were off the front lines.(25)

Four surgically equipped LST(H)s were on hand to assist with evacuation and LST(H)-929 served as a floating blood bank for the forces afloat and ashore. The LST(H)s received casualties at night and provided emergency treatment during the early stages of the operation and distributed the wounded to the APAs and AHs. On D-day, the LST(H)s evacuated 2,230 casualties between 0900 and 1530, an average of 6 casualties per minute.(26)

Originally only two hospital ships, *Samaritan* (AH-10) and *Solace* (AH-5), had been scheduled for evacuation operations. But on 20 Feb *Pinkney* (APH-2), *Bountiful* (AH-9), and *Ozark* (LSV-2), commandeered to transport the wounded, joined them. These ships evacuated casualties to Saipan and Guam and by 21 March had transported 4,879.(27)

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Naval Medical Research and Development Command Highlights

●Tissue Bubble Detector for Navy Divers

Underwater diving operations require the management of diver time and depth profiles to minimize the risk of decompression illness (DCI), commonly known as the bends. DCI is caused by the development of air bubbles in the tissues of divers when decompression occurs too rapidly. Currently, decompression techniques rely on precalculated time/depth tables or real-time computation from algorithms. However, the extremely complex physical and physiological issues relating to the etiology of DCI make predicting its onset difficult with current techniques. Under the Small Business Innovative Research program, the Naval Medical Research and Development Command has initiated a Phase II contract with Marlays, Inc. to develop a noninvasive tissue bubble detector. The detector should be capable of measuring the size and growth rate of a bubble population in living tissue. With near real-time data on tissue bubbles, scientists will be able to study and predict DCI. In turn, this knowledge could lead to better management of DCI cases and perhaps one day, the development of a portable instrument that divers could use to safely monitor their decompression procedures.

●Development of Hepatitis E Virus Vaccines

Hepatitis E virus (HEV) has been identified as a major military disease threat. Although the epidemiology of HEV has yet to be fully described, HEV infection apparently mirror hepatitis A virus (HAV) infection relative to transmission determinants. Fecal/oral transmission via contaminated water sources seems the most likely mode of spread. Evidence from outbreaks in countries like Indonesia, where hundreds of people have been afflicted at the same time, highlights the importance of HEV as an infectious disease that has the potential to impact a large number of people (such as deployed military units) at a single time and from a single source. While a vaccine to prevent HAV infection is now available, currently, there is no vaccine or specific treatment for HEV. Researchers from the Naval Medical Research Unit No. 2 (NAMRU-2), Jakarta have recently completed a comprehensive 2-year followup investigation of an HEV outbreak in West Kallmantan, Indonesia. The research findings included: household clustering of anti-HEV positives, a significant increase in cross-sectional prevalence of anti-HEV positivity with increasing age, and a positive association with the use of river water for drinking/cooking, bathing, or human water disposal and serological evidence of infection. The results of the Kallmantan investigation suggest HEV endemicity with possible reservoir maintenance in human and/or animal populations. The area investigated may prove ideal in describing the natural history of HEV and as a future site for candidate vaccine trials.

●Noninvasive Bone Structural Measurements Used to Evaluate Stress Fractures Among Female Recruits

Military personnel subject to physical fitness standards are prone to suffer musculoskeletal overuse injuries. These problems are amplified in recruit and training populations when strenuous activity is dramatically increased. These injuries often result in lost training time, failure to complete training, increased training costs, and decreased operational readiness. Researchers at the Naval Health Research Center, San Diego, CA, are working to develop predictive models of stress fractures and other overuse injuries seen in female military trainees at MCRD Parris Island, SC, by using noninvasive measurements of bone structure using a commercial bone mineral scanning system. Scanning data will be coordinated with epidemiological data to plan preventative strategies for overuse injuries among Navy and Marine Corps personnel. Study results will allow military training staffs to develop training regiments that attain the desired operational readiness with a minimum impact from these problems.

For more information on these and other research efforts by the Naval Medical Research and Development Command, contact CAPT T.J. Singer, MSC, Director, External Relations, at DSN 295-6182, Commercial 301-295-6182, FAX 301-295-4033, or E-Mail RDC03@NMRDC1.NMRDC.NNMC.NAVY.MIL.

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